

VAUGHAN (V.C.)

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BY

VICTOR C. VAUGHAN, M.D.,
OF ANN ARBOR, MICH.



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SOME REMARKS ON TYPHOID FEVER AMONG OUR SOLDIERS
DURING THE LATE WAR WITH SPAIN.

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IN August, 1898, Surgeon-General Sternberg appointed a board consisting of Major Walter Reed, U. S. A., Major E. O. Shakespeare, U. S. V., and the writer to study the causes and the spread of typhoid fever among the troops in the various camps within the United States. In accordance with this order the members of the board have been and are still engaged in this investigation. Although our work is as yet incomplete, and our conclusions may be somewhat modified after we have collected and compared more figures, we are apparently justified at present in formulating certain conclusions which may be of some interest to the profession. With the approval of the Surgeon-General and of my colleagues on the board I am permitted to present to you some of the facts that we have learned, with conclusions, which, in our opinion, are justified by these facts.

It may be well, in the first place, to say something concerning the methods which we have pursued in our investigation of this subject. In accordance with the instructions given us by the Surgeon-General we visited and carefully inspected all the larger encampments in the United States, including Camp Alger, the camps at or near Fernandina, Fla.; Jacksonville, Fla.; Huntsville, Ala.; Chickamauga Park, Ga.; Knoxville, Tenn.; Wycoff, N. Y., and Meade, Pa. In making this inspection, to which we gave about six weeks of time, we endeavored to ascertain by direct personal observation the conditions under which the soldiers lived. We visited nearly every regiment at each of these camps, made ourselves acquainted with the water-supply, the quality and quantity of the food, the preparation of the food, the nature of the soil of the camp, the space allotted to regiments, the arrangement and size of the tents and the number of men occupying each tent, the location of sinks with reference to the mess tents, the disposition of fecal matter and garbage, the thoroughness with which the camps were policed, etc. We visited regimental, division, and other hospitals, and ascertained the methods of disinfection practised in these hospitals. In short, we endeavored to see for ourselves everything that might have a bearing on the origin and spread of typhoid fever. While making this inspec-



tion we took the testimony of medical and other officers. We hoped to be able to interview at least one medical officer in each regiment, but this was not always possible. However, the information that we obtained in this tour of inspection was considerable and some of it of much value.

Since finishing the inspection we have been engaged in studying the records in the office of the Surgeon-General. In this study also we have regarded the regiment as the unit; following, however, the details of the course of the epidemic in each company constituting the command. We have endeavored to ascertain when typhoid fever first appeared in each regiment and how it afterward spread. How many cases there were in each company; if one or more companies furnished an unusually large number of cases; we have endeavored to ascertain whether or not the men in these companies have lived under unusual conditions. Thanks to the courtesy and intelligence of some of the regimental medical officers, we know how many men in each tent had typhoid fever and the initial date of each case. In our complete report we hope to give all these data, but in this paper I must content myself with general statements, substantiated by a few details.

We had not finished our first day's work at Camp Alger before we saw that one factor in the problem must be thoroughly dealt with before we could hope to reach a satisfactory solution. Fortunately we promptly took steps to acquaint ourselves with this factor. It cannot be denied that scientific medicine would have gained much had this factor been provided for at an earlier date. I refer to the question of the scientific diagnosis of typhoid fever. In the division hospital at Camp Alger we found most of the febrile cases diagnosed as malarial. We believed that they were typhoid fever, but the surgeons in charge had diagnosed them malaria. We requested that competent men, properly equipped for making blood examinations for the malarial plasmodium and the Widal test, should be sent to each of the larger camps. The Surgeon-General acted promptly on this suggestion. Drs. Gray and Carroll, of the Army Medical Museum, went to Camp Alger for this purpose. Subsequently Dr. Carroll continued this work at Jacksonville. Dr. Dock, of the University of Michigan, made investigations at Chickamauga, Knoxville, and Meade. Acting Assistant Surgeon Craig also spent several weeks in making blood examinations at Sternberg Hospital, Chickamauga Park. Dr. Curry, acting assistant surgeon at Fort Meyer, has made many hundreds of blood examinations upon sick soldiers sent from Camp Alger, Jacksonville, and other camps. As a result of the work done by these men we are able to state that malaria was a very rare disease among those troops who remained in the United States. Among the hundreds of blood examinations made on soldiers from Camp Alger the plasmodium was not found among the troops at

this place. Dr. Dock found one case at Chickamauga and one at Meade. The one at Chickamauga was a private of the Second Arkansas Volunteer Infantry, who stated that he had had chills and fever at home in the spring of 1898 before he enlisted. The malarial case at Camp Meade belonged to one of the Pennsylvania regiments. Two weeks before the examination of the blood this man came, so he stated, from a camp on the banks of the Potomac. It will be seen, therefore, that in each of these cases the plasmodium was probably introduced into the system elsewhere than at one of the large camps.

Malaria was probably more frequent than these figures indicate, but that the long continued fevers diagnosed as malaria in nearly all the field hospitals were typhoid fever, there can be no doubt. The sick reports contain evidence in themselves that malaria was not a prevalent disease among the troops. The 158th Indiana, Sixth Ohio, and First West Virginia constituted at Chickamauga Park one brigade, and were encamped side by side. From the sick reports it appears that malaria prevailed in the Indiana regiment from May throughout the summer. There were no cases in the Ohio regiment in May, three in June, eleven in July, 103 in August, and 203 in September. In the West Virginia regiment malaria does not appear on the records until August, when 108 cases are reported. That there should have been malaria in the Indiana regiment in May and not a case in either of the other regiments in the same brigade, is not probable; and that it would have taken this disease two months, had Chickamauga been the fearfully malarious place it is said by some to be, progressing slowly through the Ohio regiment to reach the West Virginia regiment, is not in accord with any known epidemiological facts concerning this disease. Pushing our inquiry further, we find that in the Ohio regiment 273 individuals are recorded as having had malaria. Sixty-six of these were sick only a few days. Among those there may have been a few cases of malaria, but the probabilities are that even for these a diagnosis of febricula would have been quite as scientific. Of the 207 cases of protracted malaria, 148 were still sick when the last report consulted by us was made (October 31, 1898). This leaves fifty-nine cases of completed malaria, among which there are quoted twelve deaths. A death-rate of more than 20 per cent. in "mild, remittent malaria," as the disease is designated by one of the surgeons, is, to say the least, unexpectedly high.

To summarize concerning the so-called protracted malarias reported by the regimental surgeons, we will say that, in our opinion, practically all of these were typhoid fever, and the following are our reasons for this opinion :

1. The uneven distribution of the so-called malaria among regiments encamped side by side gives us cause to suspect that these were not malaria.

2. Some of the surgeons who failed to record their cases as typhoid state in their comments that typhoid fever prevailed in the regiment. One illustration of this may be of interest. From April to November there were in the Sixth Ohio, according to the recorded diagnoses in the monthly reports, only two cases of typhoid fever. Notwithstanding this fact, the acting assistant surgeon in charge at that time writes in the October report the following statement: "The health of the command is improving. The prevailing disease that has caused the sickness we have had is typhoid fever." And yet the September report showed only one cases of typhoid fever, and the October report showed only one case, and this one case was one and the same patient carried from the August report on to the reports for September and October.

3. The results of several hundred blood examinations show that malaria was a very rare disease among the troops that remained in the United States.

4. Malaria as it exists in this country is easily controlled by moderate doses of quinine. All the so-called protracted malarias in our camps were treated with large doses of quinine and were not improved thereby. Consequently, we must conclude that the diagnosis given these cases was erroneous.

5. The mortality of the so-called protracted malarias corresponds with the mortality of typhoid fever, and furnishes most positive proof that these cases were not malarial.

When we began to study the regimental sick reports we found that, in order to obtain satisfactory information, we must endeavor to ascertain how many cases of typhoid fever there were in each regiment, and it soon became evident that the regimental sick reports did not give this information. Of two regiments in the same brigade, one had more than 200 cases of recognized typhoid fever, as shown by the regimental reports, while the other regiment on like evidence had only two cases, but the records of the second regiment show more than 200 cases of protracted malaria, and these furnished a mortality as high as that of the typhoid fever in the first regiment. For the reasons already given, we have included all the protracted malarias among our list of the typhoids. It may be asked how long we have considered it necessary for a so-called malaria to run in order to make it a probable typhoid. In answer to this I will state that we have regarded all so-called malarias of ten days or more in duration as possible cases of typhoid fever. We think that the great rarity of true malaria and the readiness with which these rare cases have yielded to quinine, and the fact that quinine was so generally administered, justify us in this conclusion. Practically, however, the number of doubtful cases is exceedingly small.

Typhoid fever was not only diagnosed malaria, but it was covered up by many other names. In one regiment the death-rate from pro-

longed indigestion amounted to 15 per cent. of the completed cases. In another regiment at Chickamauga dengue is a frequent diagnosis of many cases which undoubtedly were typhoid fever. That dengue should have prevailed in one regiment only among the 60,000 troops at Chickamauga is too absurd to receive serious attention. By tracing all doubtful cases to the hospitals we have been able to reach a positive opinion concerning the nature of most of them. In some regiments we have made an alphabetical list of all the sick. In others we have taken only those who are recorded as having had some intestinal disorder, malaria, or some form of continued fever. In some regiments many cases were diagnosed simply continued fever. In others the surgeons seemed to regard enteric fever as distinct from typhoid fever. The belief of some of the medical men in "typho-malaria" is evident by their reports.

The origin of typhoid fever in all the larger encampments is easily determined. Many of the volunteer regiments and some of the regular regiments were infected with typhoid fever before they reached the national camps. A few illustrations may be interesting. The Sixth Ohio reached Chickamauga Park on May 18th with a case of recognized typhoid fever. This patient was kept in the regimental hospital until he died, May 24th. The Ninth New York arrived at Chickamauga May 25th. There was a suspiciously prolonged case of diarrhoea on June 10th, and one of enteric fever three days later. The Thirty-first Michigan arrived May 17th, and furnished a recognized case of typhoid fever June 1st. The First Arkansas reached Chickamauga May 27th, and sent a probable typhoid case to the division hospital June 2d, and a recognized case of typhoid fever June 3d. The Fifty-second Iowa came May 31st, and the surgeon recognized a case of typhoid fever June 8th. The First Missouri went into camp at Chickamauga May 21st, and had a suspicious case May 31st. The Fifth Missouri came May 27th, and furnished a suspected case June 6th. The Second Kentucky arrived May 26th, and, so far as the records show, had no typhoid fever until June 26. The Second Missouri arrived May 20th, and furnished a probable case May 26th. The Twelfth New York came May 20th, and the first suspected case had its initial date ten days later. The First New Hampshire arrived May 22d, and two days later entered on its sick report a case that was most probably typhoid fever. The Eighth New York arrived May 25th, and did not show any evidence of the existence of typhoid fever until June 24th. However, as this patient died July 1st, it is probable that the true initial date was earlier than is indicated. The Second Ohio arrived May 18th, and two days later a case diagnosed as "gastro-enteritis," and which may have been typhoid fever, was treated in the regimental hospital. These are not selected regiments, but these data were taken from a bundle of records at hand at the time

of this writing, and each record in the bundle was examined. It is safe to say that more than 90 per cent. of the volunteer regiments that went to Chickamauga Park reached that place infected with typhoid fever. So wide-spread is typhoid fever in this country that in assembling a regiment of volunteers the probabilities are that one or more men in the regiment will be found to be infected with this disease at the time of enlistment. Medical officers might do well to bear this in mind and be on their guard for the detection of the first case of typhoid fever. Instead of doing this, many medical officers will refuse to recognize typhoid fever until it assumes epidemic proportions, and the records that we have studied show us that often when typhoid fever has become an epidemic some medical officers still refuse to give the disease its right name and prefer to call it something else. This aversion to calling typhoid fever by its right name seems to exist among medical officers in all armies. The German medical officer often calls the disease "gastric fever," and this term appears now and then in our records when the surgeon happens to be a German. The French call it "manoeuvre fever." I am inclined to the opinion that medical officers often are led to suppress the diagnosis of typhoid fever for fear of the alarm that it will give the patient and others. This, however, is a mistake. We will not eradicate this disease from our camps unless we early recognize its presence and take proper steps to prevent its spread. Typhoid fever in a camp should be reported to medical headquarters and to the medical officers of other regiments as diphtheria in a school should be reported.

It may be well to emphasize the fact that our troops frequently carried in their own persons the typhoid infection to the national encampment. Some acquired the disease at the State encampments and others brought it directly from their homes. In one of the Alabama regiments typhoid fever was at first confined to one company, and this company came from a town where there was an epidemic of the disease at the time when the men enlisted. From this company the disease spread through the regiment.

The next question, How did typhoid fever spread among the troops? In answering this inquiry we quite naturally first direct our attention to the drinking water. So far as our studies have been carried up to the present time, the evidence concerning water infection in the camps visited is, for the most part, negative. There is no evidence that the general water supply at the larger encampments was infected with typhoid fever. At Jacksonville the general water supply to all the regiments was from artesian wells a thousand feet deep, and infection of this water seems well-nigh impossible. Moreover, in round numbers there were at Jacksonville last August and September 30,000 soldiers and about the same number of residents. Both soldiers

and citizens used the same drinking water, and yet there was a widespread epidemic of typhoid fever among the soldiers and only a few sporadic cases among the citizens. At Knoxville the soldiers and citizens used drinking water from the same source, and at the time of our inspection, September, 1898, there were hundreds of cases of typhoid fever among the soldiers, and the records of the health officer of the city showed no evidence of the existence of the disease among the citizens. Some of the regiments at Chickamauga drank water from the creek, which might have been contaminated. These regiments suffered from typhoid fever, but other regiments which had no water from Chickamauga Creek and which brought their supply a long distance from mountain springs, the contamination of which is highly improbable, had typhoid fever just as badly as did those who drank water from Chickamauga Creek. There is another very interesting point in this connection. The three regiments of a brigade are encamped side by side; water from the same pipes is distributed alike to all these regiments; and yet typhoid fever has prevailed for twenty days and has become an epidemic in one of these regiments, while one of the others remains wholly free from the disease. A similar condition is observed when we study the distribution of the disease among the companies in a regiment. I think that we have found evidence of water infection at some of the minor camps, and it is probable that soldiers while off duty and out of camp drank from infected wells, but we are quite confident that the general water supply of the larger camps was not infected, and that water infection played a very subordinate rôle in the spread of typhoid fever among the soldiers in the camps in this country.

All know that the specific bacterium of typhoid fever is eliminated from the bodies of those sick with this disease in the urine and feces, especially in the latter, and that the disease is transmitted from one person to another by the transference of some part of the feces from the sick to the alimentary canal of the well. It follows that the spread of typhoid fever will depend upon the disposition of the excretions of those infected. On this point we have some interesting information. The first division of the Seventh Army Corps had during its stay at Jacksonville water carriage for its fecal matter. Each company was supplied with a galvanized iron trough, the lower end of which was connected with the sewer. The connection between the trough and sewer was closed by a cylindrical plug, which could be raised whenever it was desired to discharge the contents of the trough. The other end of the trough was connected with the water hydrant. The trough was partially filled with water, and in this condition received the excrement. The contents of the trough were discharged at will.

The second division of the same army corps was furnished with tubs

or half-barrels. The fecal matter and urine were received in this without the addition of lime, dirt, or anything else. When these tubs were filled they were carted away by scavengers, emptied, cleaned, and returned. The fecal matter in the tubs was always exposed to flies, the contents were often spilled about the camp and slopped out along the road.

The third division disposed of its fecal matter in pits, as is ordinarily done in camps. Orders were issued that the contents of the pits should be covered once, twice, or three times a day, differing in the different regiments. In some regiments attempts were made to compel each individual to cover his stool as soon as deposited.

It will thus be seen that in the three divisions there were three distinct methods of disposing of fecal matter. The men in these divisions were supplied with the same water, the same rations, lived in the same kind of tents, in the same climate, and, in fact, the only difference was in the method of disposing of the fecal matter. In August and September there were more cases of typhoid fever in one regiment of the second division than in all the six regiments then constituting the first division, while the third division furnished an intermediate number. It will thus be seen that when the feces were swept out of camp with a minimum possibility of camp contamination, typhoid fever was less prevalent.

The most potent factor in the spread of typhoid fever at most of the camps was camp pollution with infected fecal matter. This was true at both the large and small encampments. It was equally true of the smaller State camps, usually of one regiment, in the Northern States, and the large national encampments of one or more corps in the South. The Fifteenth Minnesota at St. Paul and Fort Snelling, the Thirty-fifth Michigan at Island Lake, and the 203d New York at Camp Black became quite as badly infected as did any of the regiments at Chickamauga, Jacksonville, or Camp Alger. The epidemic of typhoid fever was not due to sending Northern men to Southern camps; nor was it due to the massing of many regiments together, but it was due to camp pollution. In most of the camps fecal matter was deposited in pits. Flies swarmed over the infected fecal matter and then walked over the food at the mess-tents. In many of the regimental camps fecal matter was deposited about the camp on the ground. There were pieces of woodland at Chickamauga Park through which one could not walk without soiling his shoes with fecal matter. In some of the regimental camps at Tampa the sinks were overflowed by the rains, and fecal matter floated through the companies' streets. In many regiments paper soiled with fecal matter was blown about the camp. In a few instances it happened that, when a regiment was compelled to occupy a site vacated by another regiment, in digging the sinks for the newly

arrived command the men found themselves in the filled sinks of the regiment that first occupied the ground. In at least one company, a New York regiment, a small cesspool was dug in front of each tent, and this received the wash-water and probably at night the urine. In one of the Pennsylvania regiments the men of one company dug a shallow well for drinking water in a location where the water was in all probability contaminated, and this company had an unusually large number of cases of typhoid fever. At Chickamauga a soldier was found attempting to run the guard by getting into one of the barrels on the wagon on its way to the spring to bring drinking water for the regiment. We walked through the regimental camp to which this soldier belonged, and we can testify to the fact that, although we picked our way, the soles of our shoes were soiled with fecal matter before we finished the round of inspection. In this way men carried fecal matter into their tents; and clothing, blankets, and tentage undoubtedly became infected in many instances. These are some of the ways in which the infection of typhoid fever was spread.

We have considered the question of milk-supply in all the camps visited, and can state that there is no evidence that milk was a general or frequent vehicle for the distribution of typhoid fever.

We are convinced from our observations that, when water carriage for the disposition of fecal matter cannot be secured, the complete sterilization of all fecal matter is necessary to prevent the spread of typhoid fever in camps occupied for three weeks or longer. For this purpose we have recommended that each company be furnished with a specially constructed galvanized iron trough. This trough is to be partially filled with a saturated solution of milk of lime, and is to be emptied daily by means of an odorless excavator. In large camps one odorless excavator will serve a brigade, and the cost of each trough will not be more than \$15.

It must be evident to all by this time that the prevention of disease is the most important duty of army medical officers. We think that it is cheaper and no less humane to prevent sickness than it is to care for the sick. Moreover, prevention of sickness conserves the fighting force, keeps the men in good spirits, renders good discipline more easy, prevents that demoralization that comes with every epidemic, and in every way renders an army more efficient. The success of many a campaign depends as much upon the hygienic measures enforced as it does upon the military skill of the line officers. The medical officer needs special training in military hygiene, and should be selected with more care than has been exercised in the past. He should be given more authority, and then more should be expected of him.

To what extent did typhoid fever prevail among the troops encamped in this country during the summer of 1898? Owing to the aversion

shown by medical officers to diagnosing this disease correctly, as has already been mentioned, it is difficult to answer this question exactly.

The following figures show the extent to which typhoid fever prevailed among twelve regiments belonging to the First and Third Army Corps :

| Name. | Time. | No. of recognized cases. | No. of probable cases. | No. of deaths among com- pleted cases. | Total deaths. |
|---------------------|---------------------|--------------------------------|------------------------------|--|------------------|
| 12th New York . . . | May to November | 157 | 490 | 10 | 17 |
| 1st Arkansas . . . | May to September 15 | 81 | 228 | 13 | 22 |
| 8th New York . . . | May to September 9 | 190 | 425 | 16 | 21 |
| 2d Missouri . . . | May to November | 180 | 268 | 17 | 13 |
| 2d Ohio | May to October | 184 | 403 | 14 | 14 |
| 1st New Hampshire . | May to September 12 | 211 | 297 | 7 | 29 |
| 52d Iowa | May to September | 175 | 345 | 20 | 35 |
| 1st Missouri . . . | May to September 8 | 45 | 216 | 5 | 17 |
| 5th Missouri . . . | May to October | 47 | 212 | 8 | 16 |
| 31st Michigan . . . | May to October | 84 | 239 | 7 | 9 |
| 2d Kentucky . . . | May to September 15 | 89 | 286 | 14 | 27 |
| 9th New York . . . | May to September 12 | 141 | 323 | 21 | 41 |
| Total | | 1584 | 3732 | 152 | 261 |

Some explanation of this table may be desirable. The first column gives the name of the regiment; the second column indicates the period of time covered by the reports from which the data are taken. Some of the regiments were mustered out early in September, while others continued in service throughout November and even later. The third column gives the number of recorded typhoid cases in each regiment; the fourth column gives the number of cases of typhoid fever in each regiment, according to our estimate, after going over the regimental and hospital reports; the fifth column gives the number of deaths among the completed cases of probable typhoid fever; the sixth column gives the total number of deaths from disease in the regiment as reported to the War Department up to December 2, 1898. It will be seen from this table that twelve regiments furnished 3732 probable cases of typhoid fever, and we are quite thoroughly convinced that in this list of probable cases there are very few if any doubtful ones. This gives an average of a little more than 300 cases per regiment. In this list the smallest number of cases is furnished by the Fifth Missouri, which had 212, and the largest number by the Twelfth New York, which had 490.

We have tried to ascertain the mortality among the typhoid fever

cases, but at present we are not able to give any exact figures. The fifth column in the above table shows the number of deaths among the completed cases of typhoid fever. It must be understood that many of these deaths occurred among so-called malarial cases. This column foots up 152 deaths among the completed cases in the twelve regiments; there were 3732 probable cases in these regiments. This gives a mortality of a little more than 4 per cent. It must be understood, however, that this is altogether too low, because there is in this computation no data concerning the deaths among the incomplete cases. We have attempted to get the total number of deaths from the records in the War Department, and the sixth column gives us figures for the total number of deaths up to December 2, 1898. These figures indicate the total number of deaths from all diseases. That these figures are too low is shown by referring to the record for the Second Missouri in the above table. According to the figures furnished us by the War Department, there was, up to December 2, 1898, a total of thirteen deaths in this regiment, but the regimental and hospital records show us that up to November, 1898, there were seventeen deaths among the probable typhoid fevers only. Supposing that the deaths reported to us from the War Department were all due to typhoid fever, we would then have among the probable cases of typhoid fever a death-rate of a little less than 7 per cent. All that we can say, then, at present is that the death-rate among the probable typhoid cases at Chickamauga, as shown by these twelve regiments, was somewhere between 4 and 7 per cent., with the probabilities very much in favor of it being much nearer 7 than 4 per cent. Our general impression during our inspection of the regiments and hospitals was that the death-rate among the typhoid fevers was very low; but 7 per cent. or 6 per cent., or even 5 per cent., is not a low mortality for typhoid fever among soldiers. In civil practice we have a right now to expect a death-rate of not more than 7 per cent. This death-rate should be much less among men who are picked on account of their physical perfection. We will endeavor to get more exact data concerning the mortality.

It is a striking fact that the majority of the men who had typhoid fever had no preceding disease. We went into this work with the pre-conceived idea that diarrhoea and other intestinal disorders rendered men more susceptible to typhoid fever, and therefore we fully expected to find that typhoid fever prevailed more largely among those who had some form of intestinal trouble. Our studies thus far have shown us that this is not true, and that more than 80 per cent. of the typhoid fever cases do not appear upon the sick reports until they are taken with typhoid fever. As illustrating the relation between preceding intestinal disorders and typhoid fever, we will take the following from our history of typhoid fever in the First West Virginia. There were

260 cases of probable typhoid fever in this regiment. Five of these had the date of their illness in November, and four others did not belong to any company. Deducting these, the twelve companies furnished 251 cases of typhoid fever. Supposing that each company had its full quota of 106 enlisted men and three commissioned officers, then 1308 men furnished 251 cases of typhoid fever. There are 585 individuals in this regiment who are reported as having had some intestinal disorder, and apparently 723 escaped disease of this kind. The 585 persons furnished 82 cases of typhoid fever—1 to 7.13; the 723 individuals furnished 169 cases of typhoid fever—1 to 4.6. However, these figures do not represent the facts. Of the eighty-two cases of typhoid fever, forty-two were not preceded by any intestinal disorder. Therefore, 543 persons who had intestinal disorders of some kind furnished forty cases of typhoid fever—1 to 13.7; and 765 persons who had no intestinal disorder furnished 211 cases of typhoid fever—1 to 3.64. A little more than 84 per cent. of the typhoid fevers in this regiment were not preceded by any recorded intestinal disorder. It seems to us that only one conclusion can be drawn from these facts. Many of the diarrhoeas must have been due to or at least accompanied by a typhoidal infection.

Another interesting thing about the typhoid fever cases is that in a considerable number of those preceded by some disorder, whether malaria, diarrhoea, or indigestion, the disorder occurred in such close connection with the typhoid fever as to cause us to believe that it was due to or accompanied by typhoid infection. The following cases, taken from the records of the Sixth Ohio, illustrate this point. It should be stated that in this regiment all the cases of typhoid fever, with two exceptions, were diagnosed as malaria or indigestion.

No. 1.—Indigestion, August 24th to 25th; malaria, August 31st to October 8th.

No. 2.—Diarrhoea, August 16th to 17th; malaria, September 20th to October 8th.

No. 3.—Indigestion, September 11th to 13th; malaria, September 24th; died October 8th.

No. 4.—Diarrhoea, September 5th to 6th; malaria, September 10th; still sick, October 31st.

No. 5.—Indigestion, September 4th to 8th; indigestion, September 15 to 16th; malaria, September 20th; still sick, October 31st.

No. 6.—Diarrhoea, August 14th and 15th; malaria, August 18th to October 19th.

No. 7.—Continued fever, September 7th to 9th; malaria, September 10th and 11th; continued fever, September 26th; still sick, October 31st.

No. 8.—Continued fever, August 12th to 16th; malaria, August 19th to September 21st.

No. 9.—Diarrhoea, August 22d and 23d; malaria, August 25th to October 25th.

No. 10.—Diarrhoea, August 13th to 16th; malaria, August 18th; still sick, October 31st.

No. 11.—Indigestion, September 15th and 16th; continued fever, September 24th; still sick, October 31st.

No. 12.—Diarrhoea, August 12th and 13th; malaria, August 19th to September 21st.

No. 13.—Indigestion, August 5th and 6th; malaria, August 18th to October 28th.

No. 14.—Diarrhoea, September 12th to 14th; indigestion, October 14th to 16th; continued fever, October 18th; still sick, October 31st.

No. 15.—Indigestion, August 16th and 17th; malaria, August 17th to September 23d.

No. 16.—Diarrhoea, August 14th to 16th; malaria, August 18th to September 21st.

No. 17.—Diarrhoea, September 6th and 7th; malaria, September 12th; died September 22d.

No. 18.—Indigestion, August 22d to 27th; malaria, August 29th; still sick, October 31st.

No. 19.—Diarrhoea, September 2d and 3d; malaria, September 5th; still sick, October 31st.

No. 20.—Remittent malaria, September 6th to 8th; continued fever, September 10th; still sick, October 31st.

No. 21.—Indigestion, September 9th to 11th; malaria, September 14th; still sick, October 31st.

No. 22.—Diarrhoea, September 14th to 16th; continued fever, September 19th; still sick, October 31st.

No. 23.—Diarrhoea, August 20th and 21st; malaria, August 29th to September 1st; malaria, September 2d and 3d; malaria, September 5th and 6th; continued fever, September 29th; still sick, October 31st.

No. 24.—Diarrhoea, September 21st and 22d; indigestion, September 30th to October 3d; continued fever, October 6th; still sick, October 31st.

No. 25.—Diarrhoea, August 8th and 9th; diarrhoea, August 13th and 14th; malaria, August 20th to October 31st.

No. 26.—Indigestion, August 19th to 21st; continued fever, August 29th to October 24th.

No. 27.—Diarrhoea, August 4th and 5th; diarrhoea, August 7th and 8th; malaria, August 19th; still sick, October 31st.

No. 28.—Diarrhoea, September 12th to 14th; malaria, September 15th to 17th; continued fever, September 19th; still sick, October 31st.

No. 29.—Indigestion, September 15th and 16th; continued fever, September 25th; still sick, October 31st.

No. 30.—Simple fever, July 14th to 22d; diarrhoea, August 2d and 3d; continued fever, August 21st; still sick, October 31st.

No. 31.—Malaria, August 13th and 14th; malaria, August 19th to September 21st.

No. 32.—Indigestion, August 21st and 22d; malaria, August 29th; still sick, October 31st.

No. 33.—Simple fever, August 9th to 21st; malaria, August 26th to September 30th.

No. 34.—Diarrhoea, August 21st and 22d; continued fever, August to September 24th.

No. 35.—Diarrhoea, August 13th and 14th; malaria, August 29th to September 25th.

No. 36.—Diarrhoea, August 14th and 15th; diarrhoea, August 17th and 18th; malaria, August 29th; still sick, October 31st.

No. 37.—Simple fever, August 12th to 15th; diarrhea, August 20th to 24th; malaria, August 29th; still sick, October 31st.

No. 38.—Malaria, September 10th and 11th; indigestion, September 14th to 16th; malaria, September 16th; still sick, October 31st.

Hundreds of cases of this kind are recorded on the sick reports. In our opinion, the preceding illnesses in many of these cases were connected with the typhoid fever infection. The most rational explanation, so far as we can see, is that in the majority of these cases the infection was a mixed one, in which saprophytic germs greatly predominated in numbers. The preceding illnesses are believed to have been due to the action of the saprophytic micro-organisms.

In our studies we have had frequent occasion to observe that among the soldiers typhoid fever was often far advanced before it was recognized. That this was a potent factor in the spread of the disease in camps must be evident. With many unrecognized cases of typhoid fever defecating in the pits and on the ground over which men walked, drinking from the same water receptacle, eating from the same mess, and occupying tents in common with others, the chances of the transmission of the specific infection was great. This is illustrated in the Eighth New York. Many cases sent from this regiment to the New York hospitals were found to be convalescing from typhoid fever when they reached the hospital, and the disease had been diagnosed malaria prior to this time.

In military experience typhoid fever is often apparently an intermittent disease. The following cases illustrate this:

No. 1.—Intermittent malaria, August 10th to 15th; diarrhoea, August 19th to 21st; remittent malaria, August 21st to 25th; advanced typhoid fever recognized in hospital, September 9th.

No. 2.—Diarrhoea, July 30th to August 5th; intermittent malaria, August 17th to 22d; remittent malaria, August 22d; granted sick leave, August 27th; sent to Presbyterian Hospital, in New York City, September 9th, with advanced typhoid fever.

No. 3.—Intermittent malaria, August 13th to 18th; remittent malaria, August 18th; granted sick leave, August 31st; sent to St. Luke's Hospital, in New York City, September 9th, with advanced typhoid fever.

No. 4.—Intermittent malaria, August 13th to 18th; remittent malaria, August 18th to 23d; granted sick leave, August 29th; sent to St. Luke's Hospital with advanced typhoid fever, September 9th.

No. 5.—Diarrhea, July 10th and 11th; diarrhea, July 22d to 25th; diarrhea, July 30th to August 4th; intermittent malaria, July 6th to 20th; remittent malaria, August 23d to 24th; granted sick leave, August 27th; sent to Mt. Sinai Hospital, New York, September 9th, convalescing from typhoid fever.

Hundreds of other cases might be given to illustrate the apparently intermittent character of many cases of typhoid fever. We have stated that these are "apparently" intermittent. We do not intend to state that these apparent intermissions were afebrile. It is probable that a temperature-record would show that this was not the case. We mean that there were periods when the patient felt better, and for this reason was returned to duty.

The influence of change in location of camps upon the continuance of typhoid fever is exceedingly interesting. We have not investigated this subject as thoroughly as we hope to do. At present, however, I think that we can give the following conclusions:

(a) A regiment thoroughly infected with typhoid fever does not lose the disease when it changes its locality, even when it goes to a perfectly unobjectionable site and leaves all its sick behind. Evidence of this is shown in the history of the whole of the Second Division of the First Army Corps when it moved from Chickamauga to Knoxville. At Chickamauga Park this division became thoroughly saturated with typhoid fever. After reaching Knoxville, and notwithstanding the fact that the camp site was probably as fine as any in the world, the water-supply unobjectionable, the nature of the soil suitable for the digging of sinks, surface drainage good; notwithstanding all of these advantages, typhoid fever prevailed more largely than it did at Chickamauga. It is altogether probable that the clothing, blankets, and tentage of the men became thoroughly infected with the typhoid bacillus. When a regiment becomes saturated with typhoid fever, change in location alone is not sufficient to get rid promptly of the disease. We believe that it will be necessary in such a case thoroughly to disinfect clothing, blankets, tentage, etc.

(b) If a regiment be moved before the infection has become marked, typhoid fever may disappear or at least decrease.

(c) Apparently a sea voyage of some days or weeks might rid a command, not widely infected with typhoid fever, of the disease. We have some illustrations of this in the troops that went to Cuba. For instance, about half of the First Volunteer Cavalry went to Cuba, while the other half remained at Tampa. Before the departure for Cuba, and while the regiment was all together, typhoid fever appeared, and its prevalence was confined to those companies that went to Cuba. Apparently this part of the regiment lost its typhoid fever on its way to Cuba, while the part that remained behind became badly infected.

(d) A regiment thoroughly infected with typhoid fever does not lose the disease or lessen the number of cases after a short voyage at sea. This was illustrated by the Nineteenth Infantry, which, after becoming thoroughly infected with typhoid fever, was transported to Porto Rico. The progress of the disease apparently was not in the least retarded by this voyage.

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